International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 05, May - 2017

A Study on Bamboo as a Replacement of Aggregates in Self Compacting Concrete

Bhautik Dudhatra
Civil Engineering Department
Chhotubhai Gopalbhai Patel Institute of Technology
Bardoli, Gujarat, India.

Disha Parmar
Civil Engineering Department
Chhotubhai Gopalbhai Patel Institute of Technology
Bardoli, Gujarat, India.

Payal Patel
Civil Engineering Department
Chhotubhai Gopalbhai Patel Institute of Technology
Bardoli, Gujarat, India.

***Abstract*— It is a fact that the construction industry is the main consumer of energy and materials in most countries Traditionally steel is used as reinforcement in concrete structure. But because of cost and availability, replacement of steel with some other suitable materials as reinforcement is now a major concern. Though bamboo has been used as a construction material, especially in developing country, until today its use as reinforcement in concrete structure is very limited due to various uncertainties. Since bamboo is a natural, cheap and also readily available material, it can be a substitute of steel in reinforcing of concrete structure. The indiscriminate infrastructural growth is leading to rapid environmental degradation. Steel, cement, synthetic polymers and metal alloys used for construction activities are energy intensive as well as cause environmental pollution during their entire life cycle. In order to quantify the energy and CO_2 savings potential by applying best available technologies like vegetable fibers including bamboo, wastes from industry and mining etc., for engineering applications. In this study work an attempt has been made for finding bamboo as reinforcement in concrete by determining the various physical and mechanical properties of bamboo. The investigations conducted for the tested types of bamboo are evaluated using the same accepted criteria as that of steel and aggregate.**

***Keywords*— Bamboo, Compressive strength, Flexural strength.**

I. INTRODUCTION

Bamboo is versatile resource characterized by high strength to weight ratio and ease in working with simple tools. Bamboo is the fastest growing, renewable natural resource known to us. It is a small wonder, therefore, that this material was used for building extensively by our ancestors. It has a long and well established tradition as a building material throughout the tropical and sub-tropical regions. It is used in many forms of construction, particularly, for housing in rural areas. But, enough attention had not been paid towards research and development in bamboo as had been in the case with other materials of construction including timber.

Due to ecological materials and having many advantageous characteristics of bamboo, in the last few years, studies have been made on bamboo as structural material and reinforcement in concrete. Bamboo has great economic potential, especially in the developing countries, because it can be replenished within a very short time. A critical assessment of the present status and future prospects of bamboo housing would be helpful in exploiting that potential.

A. Descriptions of materials:

Cement

In this study of self compacting concrete the use of OPC 43 grade cement is carried out in the practice. OPC 43 cement shall conform to IS:8112-1989 and the designed strength of 28 days shall be minimum 43 MPa or 430 kg/sqcm. Even though 43 Grade cements' early strength is less as compared to that of 53 Grade, with time it will attain the same ultimate strength as that of 53 Grade cement. In the case of 43 Grade cement, the initial setting of cement is slower as compared to 53 Grade cement. In other words, the hydration process and consequently, the release of heat is moderate and therefore, occurrence of micro cracking is much less and can be easily controlled by proper curing of the concrete / masonry work.

Fine Aggregates

Locally available river sand is used as fine aggregate in the concrete mixes. A test for fine aggregates have been conducted as per provisions of IS: 383-1970 and IS: 2386-1963.

Coarse Aggregates

Locally available 10 mm and 20 mm crushed aggregates have been used as coarse aggregates. A test for coarse aggregates have been conducted as per provisions of IS: 383-1970 and IS: 2386-1963.

Pieces of bamboo

Bamboo fibres with size of varying length from 2 to 4 cm, breadth from 1 to 2 cm, and thickness of 1 cm is also used as a partial replacement of coarse aggregate at the replacement levels of 0%, 2%, 4% and 5%. The physical properties of all these materials were tested as per IS 383-1970.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 05, May - 2017

Figure 1. Pieces of Bamboo

B. Mix Design

Mix design is for 1 m^3 Self Compacting Concrete for M25grade

Material	Quantity (kg/m^3)
Cement	379
Fly Ash	162
Water	197
Sand	743.46
Coarse Aggregates	946.23
Water/Cement Ratio	0.364

C. Concrete Mixes

Total five concrete mixes are to be prepared for studying the parameters of self compacted concrete as a part of preliminary investigation. It is planned to cast 36 cubes of size 150mm x 150 mm x 150 mm and 24 beams of size 150mm x 150 mm x 700 mm for this study. Average result specimens for all above parameters are to be considered as the main results. Cubes of 150 mm x 150 mm x 150 mm for the compressive strength test and beams of 100 mm x 100 mm x 700 mm for the flexural strength are to be used as per IS provisions. In this study we replace of 10 mm coarse aggregate with pieces of bamboo. Size of pieces of bamboo is 1 cm x 1 cm.

Cubes and beams will cast with bamboo pieces in different percentages i.e. 0%, 2%, 4%, 5% of volume coarse aggregate. These cubes and beams will be test after 7 days, 28 days and 56 days of curing.

D. Experimental Work

Slump cone test

The slump flow is used to assess the horizontal free flow of SCC in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concrete. The test method is based on the test method for determining the slump. The diameter of the concrete circle is a measure for the filling ability of the concrete. This is a simple, rapid test procedure, though two people are needed if the T50 time is to be measured. It can be used on site, though the size of the base plate is somewhat unwieldy and level ground is essential.

It is the most commonly used test, and gives a good assessment of filling ability.

It gives no indication of the ability of the concrete to pass between reinforcement without blocking, but may give some indication of resistance to segregation.

It can be argued that the completely free flow, unrestrained by any boundaries, is not representative of what happens in practice in concrete construction, but the test can be profitably be used to assess the consistency of supply of ready-mixed concrete to a site from load to load.

Name of Mix Design	Slump Value (mm)
Mix 1	674
Mix 2	652
Mix 3	640
Mix 4	630

CASTING OF CONCRETE CUBES AND BEAMS

The test moulds are kept ready before preparing the mix. Tighten the bolts of the moulds carefully because if bolts of the moulds are not kept tight the concrete slurry coming out of the mould. Then moulds are cleaned and oiled on all contact surfaces of the moulds. The concrete is filled into moulds. The top surface of concrete is struck off level with a trowel. The number and date of casting are put on the top surface of the cubes and moulds.

Figure 2:Casting of cubes

Figure 3: Casting of Beams

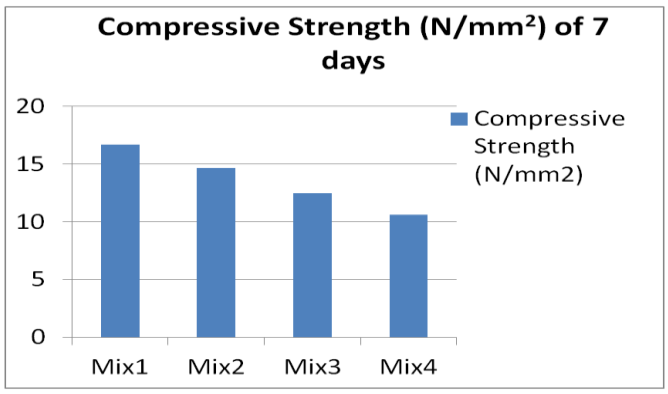
E. Tests for Concrete

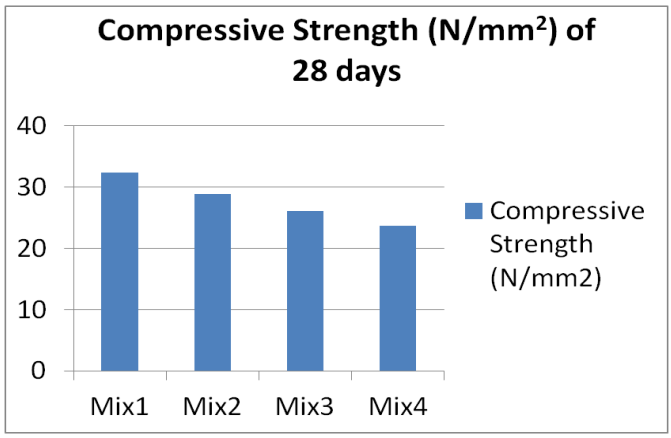
Test for Compressive strength of concrete cubes

The each cube of dimension 150 mm x 150 mm x 150 mm were tested in CTM for compression test as shown below. The load at which cube failed was recorded for every cube. Tests results are shown in table and also failure pattern of cube is shown in figure 4.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 05, May - 2017

Compressive Strength (N/mm2)			
Bamboo Percentages	7 Days	28 Days	56 Days
0%	16.69	32.40	36.55
2%	14.96	28.88	33.41
4%	12.47	26.15	30.44
5%	10.64	23.68	28.28





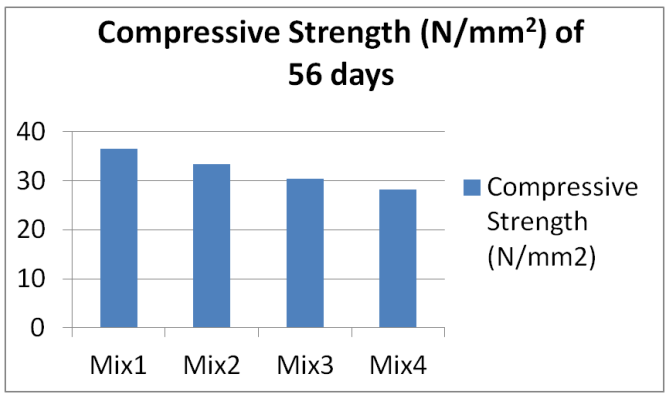
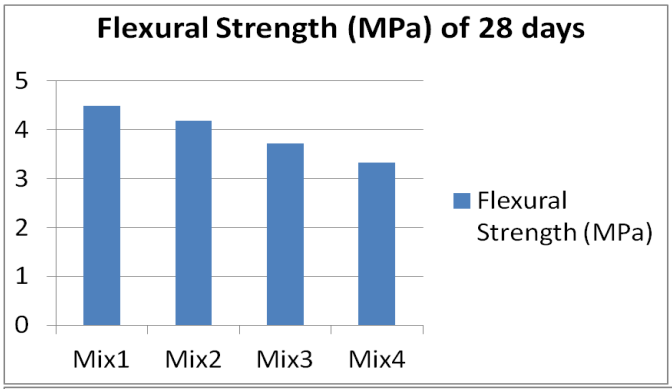


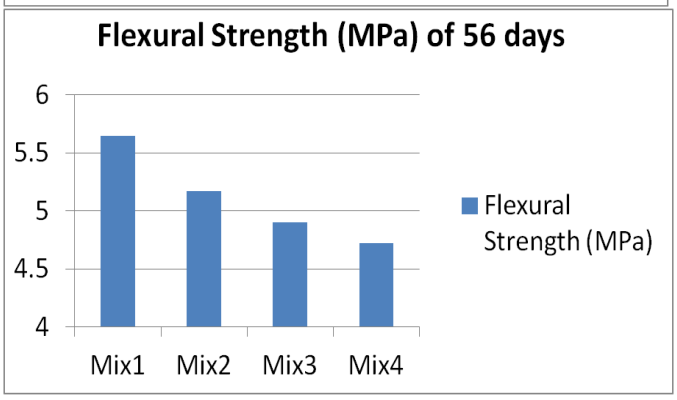
Figure 4 Failure pattern of cube

Test for Flexural strength of concrete beams

The each beam of dimension 150 mm x 150 mm x 700 mm were tested in CTM for flexural test as shown in fig.3.4. The load at which beam failed was recorded for every beam. Tests results are shown in below table and also failure pattern of beam is shown in fig 5.

Bamboo Percentages	28 Days	56 Days
0%	4.49	5.65
2%	4.18	5.17
4%	3.72	4.90
5%	3.33	4.72





International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 05, May - 2017

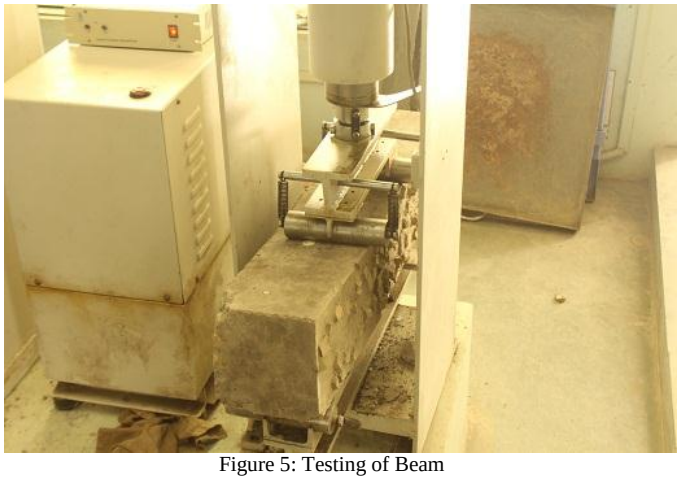


Figure 5: Testing of Beam

CONCLUSIONS

1. Slump value reduces of self compacting concrete at the higher percentage of Bamboo pieces.
2. Workability of concrete is not improved when Bamboo pieces percentage increases.
3. There is chance of segregation in Self Compacting Concrete during casting period with increases in bamboo pieces percentage.
4. It is observed that increase in bamboo pieces content of 5% decreases the compressive strength of the concrete up to 30% to 35% at the 7th days.
5. It is observed that increase in bamboo pieces content of 5% decreases the compressive strength of the concrete up to 25% to 30% at the 28th days.
6. It is observed that increase in bamboo pieces content of 5% decreases the compressive strength of the concrete up to 20% to 25% at the 56th days.
7. It is observed that increase in bamboo pieces content of 5% decreases the flexural strength of the concrete up to 20% to 25% at the 28th days.
8. It is observed that increase in bamboo pieces content of 5% decreases the Flexural strength of the concrete up to 15% to 20% at the 56th days.

ACKNOWLEDGEMENT

I have taken efforts in this paper. However, it would not have been possible without the kind support of Prof. Disha Parmar and help of Prof. Payal Patel. I would like to extend my sincere thanks to all of them. I express sincere gratitude to Hardik Patel. I am highly indebted for their guidance and constant supervision as well as for providing necessary information. I would like to express my gratitude towards my parents for giving encouragement which helped me a lot. My thanks and appreciations also go to my college (CGPIT) for providing continuous support.

REFERENCES

[1] Alireza Javadian, Mateusz Wielopolski, Ian F.C. Smith, Dirk E. Hebel, “Bond-behavior study of newly developed bamboo-composite reinforcement in concrete”, 122 (2016) 110–117
[2] Khosrow Ghavami, “Bamboo as reinforcement in structural concrete elements”, cement & concrete composites 27 (2005) 637–649
[3] Amit Singh, Shyam Kishor Kumar, A K Singh, ”Experimental investigation on flexural strength of bamboo reinforced concrete beam”, IJIRSET vol. 5, issue 5, may 2016
[4] Rameshwar Sahu, Avinash Kale, Dhiraj Choudhari, Piyush Mhatre, Prof. Rashmi Rana, “Suitability of Bamboo as Reinforcement in Column”, IJRITCC Volume: 4 Issue: 4
[5] Farhana Naznin, Dr.(Mrs) Nayanmoni Chetia, “A study on bamboo reinforced concrete beams”, (IJSAIT), vol. 4 , no.3, pages : 49 - 53 (2015)
[6] Dr. Patel Pratima, Patel Jaymin, Magdallawala Sunny, Maiwala Adit, Gajera Vivek, “Design of bamboo reinforced concrete water tank resting over firm ground”, IJEBEA 13-135; 2013
[7] Dr. Ashok Kumar Gupta, Dr. Rajiv Ganguly, Ankit Singh Mehra, “Bamboo as Green Alternative to Steel for Reinforced Concrete Elements of a Low Cost Residential Building” , EJGE Vol. 20 [2015], Bund. 6
[8] Brajesh Pandey, Vikash Kumar Singh, “Experimental Investigation on Concrete using Bamboo Fiber as Partial Replacement for Course Aggregate in Concrete” IJSRD Vol. 4 Issue 07,2016,013
[9] Bond-behavior study of newly developed bamboo-composite reinforcement in concrete, 122 (2016) 110–117
[10] Specification and Guidelines for Self Compacting Concrete, EFNARC 2002